Exhibit 1

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF GEORGIA
ATLANTA DIVISION

DONNA CURLING, *et al.* *Plaintiffs*, v. BRAD RAFFENSPERGER, *et al.*, *Defendants*.	CIVIL ACTION FILE NO. 1:17-cv-2989-AT

SUPPLEMENTAL DECLARATION OF DR. BENJAMIN ADIDA

Pursuant to 28 U.S.C. § 1746, I, BENJAMIN ADIDA, make the following declaration:

1. My name is Benjamin Adida. I am over the age of 21 years, and I am under no legal disability which would prevent me from giving this declaration. If called to testify, I would testify under oath to these facts.

2. I provided expert testimony to this Court during the September 11, 2020 Hearing on Plaintiffs' motions for preliminary injunction in the above-referenced case.

3. Following my testimony, I also reviewed the Seventh Declaration of Dr. Philip Stark, filed with the Court at [Doc. 891].

4. During my testimony on Friday September 11, 2020, I responded

to the Court's questions regarding the process of Risk-Limiting Audits ("RLA") as they will be conducted in Georgia, with our help, this November.

5. After reflection on Dr'. Stark's declaration, my testimony, and the Court's questions regarding my testimony, I became of the opinion that a more precise description and additional information may be useful for the Court in understanding the RLA process.

6. To assist the Court in this regard, the team at VotingWorks has compiled an "Explainer" document providing an overview of the process, **Attachment A**. Additionally, the Center for Tech and Civic Life, another nonprofit which assists jurisdictions with election administration and technology, has produced a video explaining the three varieties of RLAs available at https://vimeo.com/356476339.

7. Exhibit A describes the two most-common types of RLAs: ballot comparison and ballot polling audits. There are, naturally, trade-offs and limitations between the two. Specifically, while, in theory, ballot-comparison audits are more efficient, we have found (in the course of our work with numerous jurisdictions) that ballot-polling audits are easier to implement and successfully execute because they require significantly less upfront work

and do not require any specialized tabulation equipment.[1]

8. To date, ballot comparison audits have not been feasible at a statewide scale in states where all ballots are not centrally scanned, as is the case in Georgia. In our survey of states over the last year, we have not identified any state other than Colorado that is prepared to execute a ballot comparison audit in 2020. Conversely, every state we've worked with to this point can implement ballot-polling audits with the proper procedural preparations (like Georgia has done with their pilot process). Because of these practical considerations, our tool (Arlo) is focused on ballot-polling audits for 2020.

9. Regarding the purpose, or reason, for conducting an RLA, an RLA is a statistical process meant solely to validate the tabulation outcome. After reviewing Dr. Stark's Seventh Declaration, I noticed that his description of what an audit verifies implies a broader scope than what I have described, but our description aligns with Dr. Stark's published work: "Risk-limiting audits guarantee that if the vote tabulation system found the wrong winner,

[1] *See also* Mohanty, Stark, et al., *Auditing Indian Elections* (2019) at 3, https://arxiv.org/pdf/1901.03108.pdf ("Ballot-level comparison audits are more efficient in the sense that they generally involve inspecting fewer ballots to attain the same risk limit when the reported outcome is correct. However, they require more setup.").

there is a large chance of a full hand count to correct the results."[2] We do not claim that RLAs we assist jurisdictions in implementing are designed to audit anything other than the outcome as indicated by the tabulation.

10. In sum, when the vote shares of the sample being audited give sufficiently strong evidence that the reported winner really won, the audit stops and the reported outcome is confirmed as accurate within the prescribed risk limit. If the sample being audited does not provide sufficiently strong evidence, the sample expands—and continues to expand—until the sufficient evidence is collected, and may result in that sample expanding to a full hand recount.

11. Dr. Stark's seventh declaration goes on to discuss a dispute amongst academics in the election community regarding whether voters verify their ballots using ballot-marking devices. While I will not endeavor to engage in this complex discussion again and present more information than is necessary to the Court, I do wish to point out that Dr. Stark has commented on audits performed on similar—but arguably less verifiable — voting systems himself.

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[2] Lindeman and Stark, *A Gentle Introduction to Risk-Limiting Audits*, at 12, IEEE Security and Privacy, Special Issue on Electronic Voting, 2012 (last edited Mar. 16, 2012), *available at* https://www.stat.berkeley.edu/users/stark/Preprints/gentle12.pdf.

12. In *Auditing Indian Elections*, *supra* n.1, Dr. Stark and colleagues discuss how ballot comparison and ballot polling audits can be applied to General Elections in India. As Dr. Stark describes, the election equipment utilized in India consists of an Electronic Voting Machine ("EVM") and a connected printer which produces a Voter-Verifiable Paper Audit Trail ("VVPAT") that is collected in a separate container called the VVPAT Box. [3] *Id.* at 2. As Dr. Stark noted regarding audits of those machines in India: "We show how Risk-Limiting Audits (RLAs) could provide high confidence in Indian election results." *Auditing Indian Elections* at 1.

13. If a ballot polling audit could provide high confidence in the tabulation outcome when performed on paper trail produced by the Indian EVM + VVPAT system, as Dr. Stark argued, then such an audit surely can also be executed with respect to a BMD system and also provide confidence in the tabulation outcome.

14. We know that the intricacies of RLAs can be daunting and confusing, as our work with election officials in numerous jurisdictions has confirmed. In theory, ballot-comparison audits are more efficient as the

[3] For a visual description of the EVM + VVPAT system utilized in India, *see* Hindustan Times, *Watch: How to cast your vote using EVM and VVPAT*, Youtube (Apr. 10, 2019), https://www.youtube.com/watch?v=OM_SHBkQv5o.

sample size to audit is typically much smaller, but, in practice, our experience shows ballot-polling audits are easier to implement, particularly for implementation on a state-wide scale with precinct scanning.[4] Our Arlo software is the only tool available that helps states run a full state-wide audit (with the exception of Colorado, which is a central scanning jurisdiction that conducts ballot-comparison audits with its own tool). We're confident it provides the right design tradeoffs to help states quickly and meaningfully audit their paper-ballot-based tabulation outcomes.

15. I want to be clear that I am not purporting to alter the substance of my testimony by this declaration, but want to ensure clarity as to the process VotingWorks utilizes (and is utilizing with Georgia election officials).

[*Signature on following page*]

[4] *See also*, Lindeman and Stark, *A Gentle Introduction*, *supra* n.2, at 3 ("Since ballot-polling audits do not require data from the vote tabulation system, they are an immediate practical option for auditing large contests . . . Comparison audits, described next, generally involve examining fewer ballots, but require much more from the vote tabulation system.")

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed this 17th day of September, 2020.

BENJAMIN ADIDA, Ph.D.

Attachment A

Supplemental Declaration of Dr. Adida

Risk-Limiting Audits:
Ensuring that the Winner Actually Won

Goal and Function of RLAs

Trusted elections are critical to a functioning democracy. As concerns about cybersecurity in elections have grown, election officials have increasingly returned to voting systems that produce a paper trail of votes via paper ballots. Paper ballots allow voters to double-check their votes before casting their ballot, and also give election administrators a physical record of votes that can be examined before the election results are finalized.

Even in paper-based voting systems, however, one piece of technology still stands between the paper ballot a voter can check and the final vote tally: scanners that interpret the marks on paper as votes and count those votes, called "tabulators[1]." Risk-limiting audits (RLAs) provide a check on these tabulators, and can provide confidence that the reported outcome of an election is correct - that the winner actually won. In some cases, the margin of the election is close enough that a full hand recount is necessary to provide this validation, but in others the outcome can be confirmed by examining a smaller, representative sample of the ballots.

RLA Process

1. The first step is to select which contest(s) to audit. This choice depends on a number of factors, including: the margin of the contest, whether all the ballots for the contest are able to be audited, which jurisdictions are participating in the audit, etc.

[1] Machine counts of ballots are desirable for two reasons. First, they produce results quickly. Second, machine counts can produce a more precise and unbiased tally for large quantities of ballots and votes than hand-counting, avoiding some of the errors that occur with repetitive human counts at scale.

2. Next, select the risk limit for the audit (usually between 5 and 10%). The risk limit is the largest possible chance that the audit will fail to correct an incorrect election outcome. For example, a 5% risk limit means that if the reported winner is wrong, the RLA will find that error and correct the winner at least 95% of the time. The lower the risk limit, the more ballots need to be manually examined in order to complete the RLA.

3. Based on the type of RLA and the details of the contest (contest margins, votes cast, etc.), RLA software is used to calculate how many ballots or ballot cards need to be audited. In this way the expected workload can be planned for, though which specific ballots will be audited is deliberately left unknown to avoid any pre-audit tampering.

4. Each local jurisdiction participating in the audit provides its ballot manifest, which is much like a shipping manifest - a list of all the containers where cast ballots are stored and the number of ballots (or ballot cards, if multi-page ballots) in each container. During the RLA, the manifest is used to randomly select ballots for the audit and tell auditors where to locate each selected ballot. The ballot manifest is created using data from outside the tabulation system (e.g. the manifest cannot simply be the batch totals from the scanner) to prevent tabulation errors from impacting the audit.
    a. All RLA methods require a ballot manifest; the ballot-comparison RLA method also requires an ordered cast-vote-record (CVR) file from the voting system indicating how the system interpreted each ballot, and the batch-comparison RLA method requires batch-by-batch vote totals for every candidate. Which method of RLA is appropriate often depends on the availability of these additional data sources, which varies based on different voting systems and election administration practices.

5. Once all the source data for the audit is confirmed, a random seed is generated. This seed is fed into the audit software's pseudorandom number generator to randomly select a list of ballots for audit. There is often a public ceremony to generate the random seed - and ensure it is actually random. The VotingWorks Arlo practice follows the Colorado example and rolls twenty ten-sided dice in a public ceremony to create the random seed.

6. The audit software provides each jurisdiction with a list of the ballots chosen for audit within their jurisdiction, organized for efficient retrieval.

7. Each local jurisdiction retrieves the designated ballots from their storage containers, maintaining chain of custody by logging which containers are opened, by whom, and when, as well as checking the seals on each container. Auditors carefully label each audited ballot as it is removed and place a labeled placeholder page into the container in place of the ballot, so that all ballots could be "reshelved" if necessary. Containers are handled one-at-a-time by each audit board so that ballots from different containers don't mix, and are returned to custody and resealed (with appropriate logging) as soon as retrieval is complete.

8. Audit boards of at least two people in each jurisdiction examine the human-readable text on every ballot and record the votes they see.

9. The audit software uses these audited votes and the originally-reported votes to determine if the audited ballots provide sufficient evidence that the outcome is correct. If the calculations show a risk measurement below the risk limit, the audit is complete. If not, additional ballots will be randomly selected to expand the sample size, and the process of retrieval and auditing continues until the risk measurement falls below the risk limit or all ballots have been examined (a full hand recount).

History & Development

Audits designed to check how votes were counted, called post-election tabulation audits, have been a longstanding part of election administration[2]. In these audits, officials compare the votes on a random sample of paper ballots with the results generated by a machine count of those same ballots, always depending on appropriate physical security and chain of custody processes to ensure the credibility of the paper ballots. Traditionally, post-election tabulation audits examine a fixed percentage of randomly-chosen voting districts or machines from each election, usually between one and five percent. However, statisticians argue that the utility of these "traditional" tabulation audits is limited.

Fixed-percentage audits can find individual vote-counting errors in a particular group of ballots if that segment of ballots happens to be audited, but rarely provide the representative sample needed to confirm or correct the overall winner of a contest. Officials conducting these audits often look at more or fewer ballots than necessary to draw a conclusion about whether the winner actually won, and the degree of validation provided by the audit fluctuates from election to election depending on which ballots are audited. Traditional tabulation audits are also prone to misinterpretation; individual vote counting errors, while incredibly useful for an election official's own quality-assurance purposes, tend to cast doubt on the election outcome even when they have no impact on who won the contest. Given that no election is 100% error free, auditing to find the *presence* of problems without any indication of the *effect* of those problems provides limited value in terms of risk management and can damage voter confidence.

By contrast, RLAs focus explicitly on confirming the winner of the election if that outcome is correct, or correcting the outcome if necessary. Any tabulation errors recorded are presented in the context of their effect (if any) on who won the election. RLAs also allow officials to control the chance of error in the RLA process itself via the risk limit, which can be thought of as the maximum chance of a false-positive audit result (e.g. an audit that confirms an incorrect winner). Election officials set the risk limit prior to the audit and then then examine the number of ballots required to meet that threshold, never auditing more or less than necessary. This balance of efficiency and accuracy makes RLAs practical as a standard part of the election validation

[2] See https://www.ncsl.org/research/elections-and-campaigns/post-election-audits635926066.aspx.

process while ensuring that the results of the audit are consistently trustworthy across election cycles.

Limitations of RLAs

Risk-limiting audits are meant to check that a full hand recount of the paper ballots would produce the same winner. To the extent that they check tabulation, it is only to the point of confirming that the correct winner was found; in particular, an RLA does not confirm the exact vote count for any candidate. Also, an RLA does not inherently ensure that other parts of the voting process – voter registration, access to the ballot, pollworker processes, etc. – have been performed correctly. An RLA is one of many checks and balances necessary to ensure that an election result is valid. In current practice, the RLA is chiefly useful for addressing cybersecurity concerns inherent in machine tabulation of paper ballots.

Basic Requirements

The requirements necessary to conduct a valid RLA, as broadly agreed upon by election integrity advocates and election security professionals, are best expressed in the 2018 publication *Principles and Best Practices for Post-Election Tabulation Audits*[3]. VotingWorks endorses these principles, which are as follows:

> "Principles for Tabulation Audits
>
> 1. EXAMINATION OF VOTER-VERIFIABLE PAPER BALLOTS:
> Audits require human examination of voter-marked paper ballots — the ground truth of the election. Voter-marked paper ballots may be marked by hand or by ballot marking device. Audits cannot rely on scanned images or machine interpretations of the ballots to accurately reflect voter intent.
>
> 2. TRANSPARENCY:
> Elections belong to the public. The public must be able to observe the audit and verify that it has been conducted correctly, without interfering with the process.
>
> 3. SEPARATION OF RESPONSIBILITIES:
> Neither the policy and regulation setting for the audit, nor the authority to judge whether an audit has satisfied those regulations, shall be solely in the hands of any entity directly involved with the tabulation of the ballots or the examination of ballots during the audit.
>
> 4. BALLOT PROTECTION:
> All the ballots being tabulated and audited must be verifiably protected from loss, substitution, alteration or addition.

[3] https://verifiedvoting.org/publication/principles-and-best-practices-for-post-election-tabulation-audits/

5. COMPREHENSIVENESS:
All jurisdictions and all validly cast ballots, including absentee, mail-in and accepted provisional ballots, must be taken into account. No contest should be excluded a priori from auditing, although some contests may be prioritized.

6. APPROPRIATE STATISTICAL DESIGN:
Audits should produce and scientifically assess evidence about tabulation accuracy while making efficient use of available resources. A risk-limiting audit (RLA) with a small risk limit assures a large chance that an incorrect outcome will be detected and corrected.

7. RESPONSIVENESS TO PARTICULAR CIRCUMSTANCES:
Audit processes must include a way to respond to circumstances that come to light affecting particular devices, ballots or contests.

8. BINDING ON OFFICIAL OUTCOMES: Audits, including any full hand counts that result, must be completed in time to change official outcomes if hand counts so indicate.

9. INVESTIGATING DISCREPANCIES AND PROMOTING CONTINUOUS IMPROVEMENT:
The data gathered from post-election audits should be analyzed and used to continuously improve voting processes."

RLA Methods

There are two main methods of RLAs in use currently: **ballot comparison audits** and **ballot polling audits**.

In a **ballot-comparison audit**, auditors retrieve the physical paper ballots selected for audit and record the votes they see on the ballot into the audit software. The audit software then compares these audited votes to the digital record of how the scanner counted that same ballot, and determines whether any errors detected matter to the outcome of the election. This one-to-one comparison is particularly powerful, and allows the audit to reach a conclusion with surprisingly few ballots audited. The trade-off is that a ballot-comparison audit can only be performed if each physical ballot and its digital representation can be reliably matched up after scanning and storage. This requires a significant amount of up-front work to ensure that ballots are always stored in the order they were scanned, and usually requires scanning everything centrally, in small batches, and imprinting a unique identifier on each paper ballot after it is scanned to catch any shuffling that happens inadvertently. The voting equipment used must also provide an ordered cast-vote-record for all ballots. At this time, ballot comparison audits are only feasible at scale in central-count states like Colorado, Washington, and Oregon. Ballot-comparison audits in states with precinct-count systems, where precinct scanners deliberately shuffle the ballots to protect voter anonymity, are not yet practical.

In a **ballot-polling audit**, auditors retrieve the physical paper ballots selected for audit and record the votes they see on the ballot into the audit software. The audit software then uses the results from the audited ballots and the results reported from the original tabulation to determine if the sample provides sufficient evidence of a correct outcome. If a large enough sample shows a large enough margin for the reported winner, the audit is complete. If not, more ballots are sampled until the statistical condition is met, or until a full hand recount is performed. A ballot-polling audit requires sampling more ballots than a ballot-comparison audit. On the other hand, it requires significantly less up-front work than ballot-comparison audits: ballots do not need to be imprinted with an identifier nor does their exact scan order need to be preserved in storage. No additional source data beyond the ballot manifest is required. Ballot-polling audits are also most compatible with existing ballot storage practices, and can be implemented with minimal changes to election administrators' existing practices.

While ballot-comparison audits require auditing fewer ballots, efficiency in the number of ballots audited is not the only concern when deciding which RLA method to use. In practice, most states are limited by their existing voting systems, election administration practices, legal requirements, and ballot storage procedures. Changing these systems is not impossible, but should also not be a requirement before robust audits are implemented. Thus, ballot-polling audits, even as they require more back-end work in the form of a larger sample of ballots, are significantly more practical for most states as a starting point. It is for this reason that Arlo, the VotingWorks RLA tool, has focused on optimizing ballot-polling audits for 2020.

There is a third flavor of RLA: **batch-comparison audits**, where a sample of the *batches* of ballots are selected, and a hand tally of each batch is compared to the tabulator's claimed tally for that batch. Batch-comparison audits are not used very often because their workload is less predictable and sometimes more intensive than ballot polling audits.

The Center for Tech and Civic Life has produced an animation video that succinctly explains these three RLA methods: https://vimeo.com/356476339.

Tabulation Equipment is *NOT* involved in the RLA

Critically, an RLA does *not* involve the tabulation equipment used to produce the initial tallies. The scanning equipment is used only during the initial election tabulation to produce the original results. For this reason, any QR codes that may be present on ballots are irrelevant and are not a concern: the RLA looks only at the human-readable text on the ballot that voters themselves saw and confirmed. Thus, an RLA catches meaningful discrepancies between the human-readable text and the reported result, which means that an RLA would catch meaningful discrepancies in QR code encoding, as those are part of the tabulation workflow.